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ABSTRACT

One of a series of experimental units for preschool children, this unit deals with patterns and number concepts. The mathematical background, the organization of the unit, and the objectives are discussed; a list of materials is provided; and directions are given for a sequence of learning activities. For the document reporting the development and evaluation of this unit, see SE 016 125; for other units in this series, see SE 016 124 through SE 016 128. (DT)

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MATHEMATICS EDUCATION

PATTERNS

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PATTERNS

by

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NOTE TO TEACHER

This is an experimental unit on patterns and number concepts. The idea is to help the children explore patterns first and, when the concept of a "pattern" is successfully established, use the exploration of patterns as a way of working with number concepts. PATTERNS is not to be the only introduction to numbers but will be one of many avenues leading to this concept.

It is the intent of the author of this unit to make these activities so naturally pleasant for the children that they will engage in them voluntarily. Please try to make the suggested activities game like or playful in spirit.

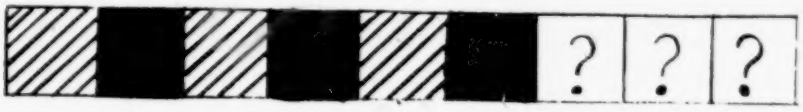
Throughout this unit children will be encouraged to do a variety of tasks, some more difficult and some less difficult. Every child will experience failures and successes. Of course a correct answer deserves a "rewarding" response, one which indicates that you are pleased with the child and are happy that he has succeeded. If a child does a task incorrectly how shall we respond? Try not to say "no" or "that is wrong." Instead, compare the child's work with the standard--that is, your pattern or the one in the book, if this is possible, and let the child conclude from observation that he has made a mistake. On some pattern problems this will be impossible, and you will have to indicate yourself that the student's work is not correct.

Please let us know if you find difficulty in using this material. We stand ready to help you change or supplement the material, or to assist you in using it.

William D. McKillip

MATHEMATICAL BACKGROUND

There are two major mathematical ideas emphasized in this: Number concepts and inductive thinking. Both of these are introduced through patterns of colored blocks. The child is encouraged in these activities to think inductively about number concepts. Look:



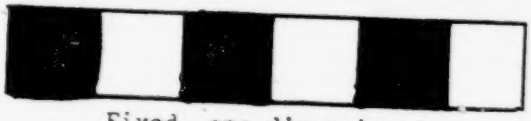
(A)

Do you know what shading, solid or striped, the next three squares will have? How can you be so sure? Most people, including very young children, recognize that the pattern established by the 6 squares is stripe-solid, stripe-solid, stripe-solid. They then predict that the pattern will continue in the same way. More complicated patterns, also, can be recognized and succeeding pattern elements predicted.

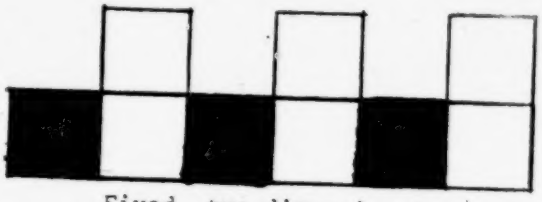
(B)

This pattern differs from pattern A in having one shaded square followed by 2 striped squares and so forth. A mathematical description of pattern A would be 1, 1, 1, 1, .. ., while for pattern B the mathematical description is 1, 2, 1, 2, 1, 2, .. . In this way both introductory work with number concepts and practice in inductive thinking has been included in the unit.

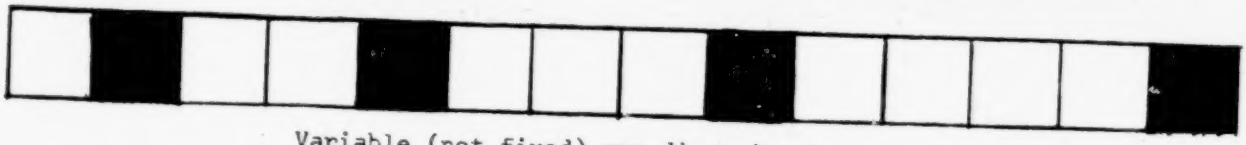
Some of the ideas such as "fixed patterns" and "variable patterns" will become clearer when you study the following patterns.



Fixed, one dimensional



Fixed, two dimensional



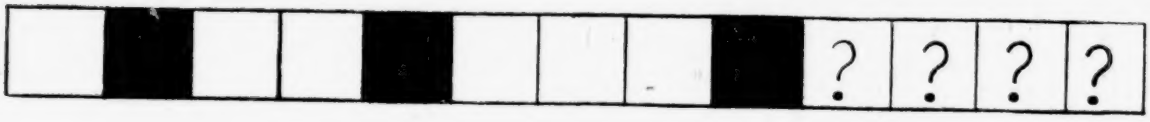
Variable (not fixed) one-dimensional

Variable, two-dimensional

Patterns are "one-dimensional" if the blocks are arranged in a single row. If the blocks are arranged in more than one row the pattern is two-dimensional. A fixed pattern is one which has repeating regularity. A variable pattern has a systematic irregularity as shown in the examples above.

The children will first be asked to duplicate(copy) one- and two-dimensional patterns, both fixed and variable. This involves observation skills and pattern recognition. The children will then extend these patterns, a task which involves number concepts and inductive thinking.

One of th.. main purposes of this unit is to encourage children to do inductive thinking. Consider the following pattern:



Most adults guess that if the pattern were extended, four white blocks would come next. How do they arrive at this conclusion? By using number concepts and inductive thinking. In this example there is one white block, a black, then two white blocks, a black, then three white blocks, a black, so naturally (or inductively) four white blocks would come next.

UNIT ORGANIZATION

The organization of this material into "daily lessons" is not attempted here. The activities are sequenced in a way which we consider natural and desirable, but what you and the children are able to do in a day depends on many factors which cannot be anticipated.

Feel free to skip any activities which the children have mastered, but first verify that the concepts and ideas involved are clear to the children. If you feel that your group could benefit at any point from more material than is provided, you may either invent it yourself, keeping a record of what you do, or inform us and we will supply the materials you need.

The material in this unit is organized in an order we believe reflects increasing complexity of the activities.

Activity 1	Free Play and Sorting
Activity 2	Duplicating Fixed Patterns
Activity 3	Extending Fixed Patterns
Activity 4	Two-dimensional Patterns
Activity 5	Variable Patterns

The student materials for this unit are designed to provide practice in the use of a book. Pages are designated by a number of ducks at the bottom of the page. An instruction might be, "Turn to the page with four ducks. Count the ducks to be sure you have the right page."

UNIT OBJECTIVES

Mathematical Content Objectives:

1. The child develops or reinforces number concepts.
2. The child begins to develop inductive reasoning skill.
3. The child develops observation skills.
4. The child develops pattern recognition and utilization.

Word Usage Objectives:

The child uses the following words and phrases with understanding:

1. Two patterns are the "same" or they are "different
2. To "duplicate" a pattern means to copy a pattern.
3. To "extend" a pattern is to make it longer.

Behavioral Criteria:

All statements about patterns refer to arrangements of square blocks or tiles in two-color states and are applicable to one- and two-dimensional patterns.

1. The child can duplicate fixed patterns.

2. The child can extend fixed patterns.

3. The child can duplicate variable patterns.

4. The child can extend variable patterns.

5. The child can complete missing interior parts of patterns.

6. The child can describe a pattern.

7. The child can construct a pattern when given the pattern description.

Evaluation:

We need to determine whether this unit is in fact accomplishing the objectives we have outlined or, more precisely, we need to know to what degree these objectives are being accomplished with children of different ages. We ask your cooperation in filling in and returning to us the Evaluation Sheets, if any are provided.

MATERIALS

For this unit a supply of one-inch-cubical blocks or one-inch-square ceramic tiles will be needed. Wooden blocks are nice, but ceramic tiles serve equally well and are less expensive. If you decide to use tiles, these should be one inch square and approximately 1/4 inch thick. One-inch squares of poster paper might be used, but these are less satisfactory.

The number of blocks or tiles needed will depend on the size of the class. There should be enough blocks to give each child 20.

Half the blocks or tiles or paper squares should be white or natural color and the other half red. Storage boxes for the blocks or tiles should be colored to match the contents.

You will also need a supply of poster paper of two different colors, one light and one dark. If possible, the colors of the poster paper should

match the colors of the blocks or tiles. Cut out squares about one foot on each side for use in making patterns visible to all the children.

You will need one copy of the student text, appendix A, for each child and at least one copy of each work sheet, appendix B, for each child.

In this unit we will assume that you have gathered the materials described in this section and that they are readily available in your room. We will not, therefore, list what is needed lesson by lesson. Whether you use blocks or tiles is of no consequence in the conduct of the unit, but from this point on we will talk only about blocks.

Activity Sequence 1

Free Play and Sorting

Introduction:

Children like to play with a new toy for a while without having anyone tell them how it works or what they are supposed to do with it. Give the children enough free-play time to allow them to become familiar with the blocks. It seems a good idea to restrict the use of the blocks to a fairly definite time period and to use them only at a table; thus these blocks will come to signify a particular activity to the children. What the children build or do with the blocks during this free-play period is unimportant. When the time comes to clean up, put the blocks in the box of matching color. This begins to introduce the idea of sorting the blocks by color. Name the colors. During the day find other objects of the same colors in the room. The words "same" and "different" are appropriate here; two blocks are the same color or they are different colors; this block is the same color as this box but it is a different color from that box. Invent more instances of the use of "same" and "different."

Objectives:

1. The children should become familiar with the blocks and accustomed to playing with them.
2. The children should learn to sort by color (red and white) and learn (or reinforce) the concepts "same" and "different" as they relate to block colors.

Activities:

1. Free play. 15 to 20 minutes per day; longer if the children show a great deal of interest, less if they seem bored.

2. Sorting. At the end of each day's play, sort the blocks into the boxes of matching color. Emphasize "same" and "different."
3. Color recognition. At appropriate times during the entire day call attention to objects which are red or white, and to other colors.

The free-play activity gradually phases into Activity Sequence 2, Duplicating Fixed Patterns. The time at which this gradual change should begin is largely a matter of teacher judgement. We think that a free-play period of one week might be about right at age 3, while at age 5 a few days will probably be adequate. When symptoms of boredom occur, a change is definitely indicated. After at most one week free play, try to introduce the next activity.

Activity Sequence 2

Duplicating Fixed Patterns

Introduction:

The change from free play to duplicating patterns should be gradual. When the children are willing to "play a new game" with the blocks, interrupting their free play, then we are ready to introduce the idea of duplicating a pattern. To reduce the "grabbyness" which will develop when a number of children work at the same table, give each child seven to ten blocks, be sure each child has the same number of blocks, and do not leave the supply of blocks out on the table.

Objectives:

1. The children learn to duplicate exactly a pattern of blocks made by the teacher, either (1) a block at a time as the teacher builds it or (2) by copying from the completed pattern.
2. The children learn to duplicate a pattern of blocks symbolized in a book.
3. The children learn to fill in missing elements of a pattern using the work sheets.
4. The children learn to describe a pattern.

Activities:

1. The teacher makes a pattern with the blocks, and each child makes a pattern exactly like it. The first stage in this activity involves only fixed, one-dimensional patterns.
   a. Say, "Make a wall that looks like mine" or "Make a row of blocks that looks just like mine."

b. It is possible that two different levels of performance may be found. One is the ability to duplicate a pattern which was completely constructed beforehand. A second is to build a row of blocks with the teacher one at a time, matching each block the teacher adds with a block of the same color. Try to get the children to duplicate whole rows but use block-at-a-time duplication if that seems to help a child get started.

c. The physical distance from your pattern to the child's copy is an important variable. The greater the distance the more difficult the task. When a child has difficulty copying your pattern try this:

Step 1. Move your pattern next to his copy like this.

(yours)

(his)

Ask, "Are they the same?" No matter what the answer say, "Make yours look just like mine." If the child cannot do this, say "I will make mine look just like yours," then do it. Result:

(yours)

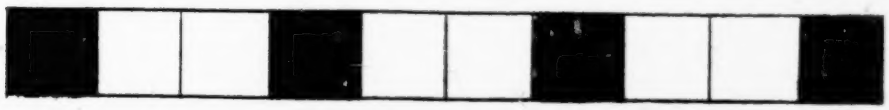
(his)

Step 2: Say "Now they are just alike; they are the same." Change your pattern back the way it was at Step 1. Now say "Make yours just like mine."

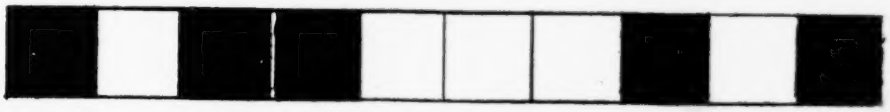
d. The following are all fixed one-dimensional patterns. Use these and other fixed one-dimensional patterns for this activity.

(1)

(2)

(3) 

(4)

(5) 

(NOTE: The block above is random. Do the children notice the absense of pattern?)

(6)

(7)

2. Use The Duck Book. Can children duplicate a pattern they see symbolized in this book? Use the how-many-ducks scheme for page location. Older children may understand the counting operation clearly and not need this practice.

   a. At first children may put their blocks directly on the page in The Duck Book, and this is permissible. It makes the copying task easy and helps some children get started.

   b. Soon, however, you should encourage all children to make their copy on the table and not directly on the page they are using.

3. Make a pattern in the front of the room for the children to copy with their blocks. Use 1' x 1' squares of cardboard standing in the chalk tray to form the pattern.

4. Divide the class into two groups. Let one group make up a pattern using the large squares in the chalk tray, on a table, or on the floor. You have a choice of two methods:

   a. When one group has made up a pattern with the large squares (as in 4), each member of the second group should copy the pattern with his own blocks.

   b. Let the other group (working as a group) copy the pattern with their own large squares.

5. Use an overhead projector. Cut uniform squares from two different colored transparent sheets and arrange a pattern on the overhead projector, or make transparancies using as master sheets the pages of Appendix B.

Because of the greater physical distance from the pattern to the child's copy in Activities 3, 4, and 5, the tasks will be more difficult. Some children will need to review before starting these activities.

6. Repeat Activity 3, but this time describe the pattern to the children.

a. A description of the pattern above could be, "This pattern has one white, then two red, then one white, then two red, then one white." You might say, "This pattern starts with white and goes one, two, one, two, one."

b. You might have to ask the child how many blocks are in the pattern and how many blocks of each color are in the pattern. In order to obtain a detailed description of the order and number of a pattern, you might say "Tell me how your pattern is made," or " How does your pattern go?" Children should be encouraged to talk about their patterns, describing them to one another.

Activity Sequence 3

Extending Fixed Patterns

Introduction:

This activity is the first one which requires a child to decide for himself what block to put in a space rather than just copy. The idea is to teach the child to attend to patterns so that he can predict what the next pattern element will be. For example, in the following row of blocks most people will immediately say that the next block should be _____.

Objectives:

1. The children learn to extend a patterned row of blocks by continuing the pattern.
2. The children learn to extend patterns seen in a book.
3. The children learn to construct a pattern when given description and can then extend the pattern.

Activities:

1. Give the children two or three repetitions of a pattern and ask them to "Build more like this" or "Make the wall longer." Use the patterns on page 12, on the work sheets, and in the Duck Book; make up others if you wish.
2. In this activity we would like to have the children extend patterns

in the Duck Book. They should first duplicate the pattern they find there and then extend it.

3. Use the "giant squares." Again have the children duplicate the pattern using blocks at their tables and then extend it.

4. Let each child hold a "giant" square in front of him. Divide the children into two groups of 6 to 8 in each group. Make two lines on the floor with chalk with an X for each child to stand on. Let the first group "hide their eyes" while the second group forms a pattern. Then let the first group try to duplicate the pattern. After the first group duplicates the pattern, have the children march forward and meet to check (see diagram). This activity is likely to be successful with older children.

5. Describe a pattern to the children and have them construct and then extend the pattern. Note: Some children may need a review of Activity 6 in the preceeding Activity Sequence. Give the children the pattern description frequently as they work.

6. Use work sheets 1, 2, 3, 4, 6, and 7. The children first put a work sheet on the table and then place the blocks directly on the sheet, covering a white square with a white block and a black square with a colored block. The "blotted out" area should be covered with blocks so as to preserve the pattern.

Activity Sequence 4

Two-dimensional Patterns

Introduction:

It seems natural to try patterns which are formed in two dimensions rather than in one line only. Copying or extending a pattern in two dimensions will require a child to consider the blocks above and below as well as the blocks to the left and right of the block he is placing. We have again in this activity the three kinds of tasks for the children: Copying patterns formed by the teacher, copying patterns from a book, and filling in blots on the work sheets.

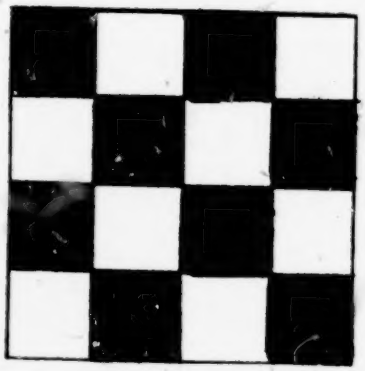
Objective:

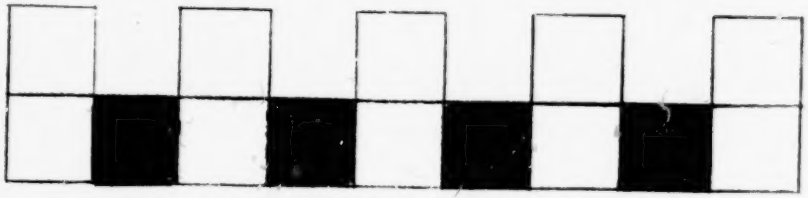
1. To learn to copy patterns in two dimensions and to supply missing pattern elements.

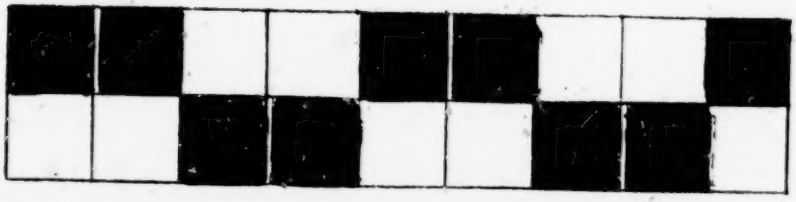
Activity:

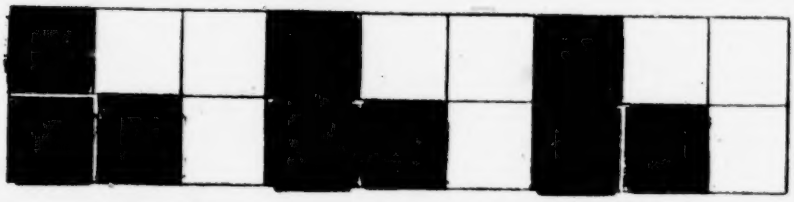
1. Using the two-dimensional patterns on the next page and others which you may make up yourself, have the children duplicate the patterns. Instructions for this activity might be "Can you make a wall like mine?" or "Can you make rows of blocks just like mine?"
2. Duplicate patterns from the book as before.
3. Use the "something spilled" work sheets. Mark each work sheet with the child's name, and indicate on the sheet whether the child correctly completed the pattern.

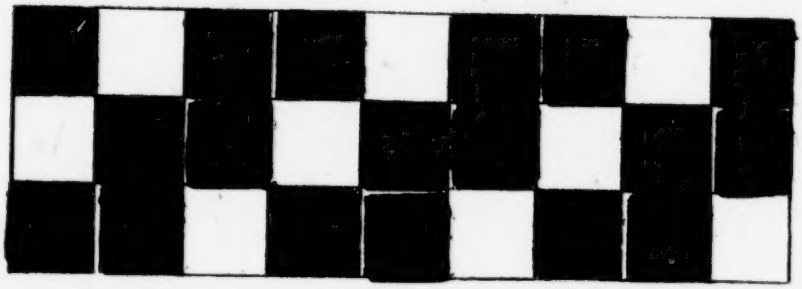
Two dimensional patterns:









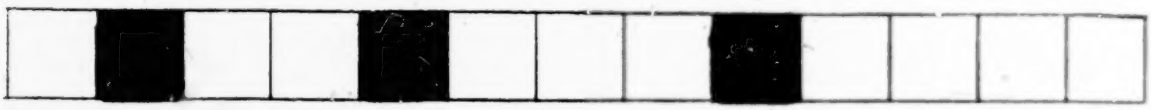


Activity Sequence 5

Variable Patterns

Introduction:

A pattern is "variable" if the arrangement changes in some way. In particular we intend to make patterns which vary in the number of elements in their component parts. As an example, look at the pattern here:



This pattern is changed by increasing the number of white blocks in each succeeding group of white blocks by one. A child who duplicates this pattern has either considered this number relation or has performed a block-at-a-time duplication. A child who correctly fills in missing blocks in such a pattern or who extends the pattern has certainly used number concepts. We have included all the basic activities in this activity sequence: duplicating patterns, filling in blots, extending patterns and using teacher-example and book materials as a source of patterns. We have also used both one-and two-dimensional patterns as the children are now familiar with both.

Objectives:

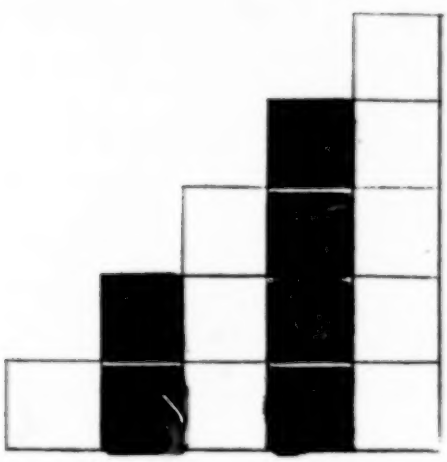
1. The students learn to duplicate variable patterns.
2. The students learn to extend variable patterns and fill in missing pattern elements.
3. The students learn to construct a pattern when given the pattern description and can then extend the pattern.

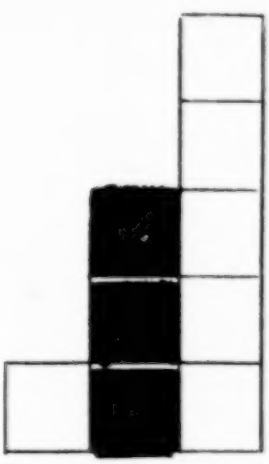
Activities:

1. Duplicate variable patterns from teacher-example and from the book.
2. Fill in missing pattern elements on the blot work sheets.
3. Extending variable patterns. This activity will probably be very difficult for some children, but it is also most important. If necessary, reinforce the child's concepts by saying "Let's count the white blocks, the red, etc." (for example) "There are two white blocks, then one red, then three white blocks, then one red; we have two then one, then three, then one, then _____
4. Give the children a description of a variable pattern and have them construct the pattern and then extend it.

Patterns

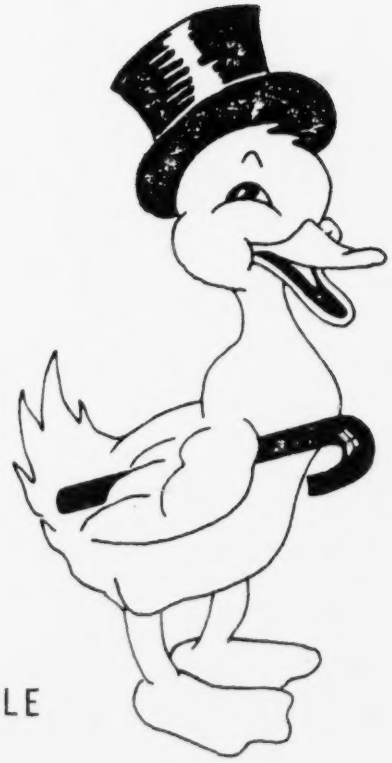
The following patterns and others you make up may be used for duplicating and extending activities.





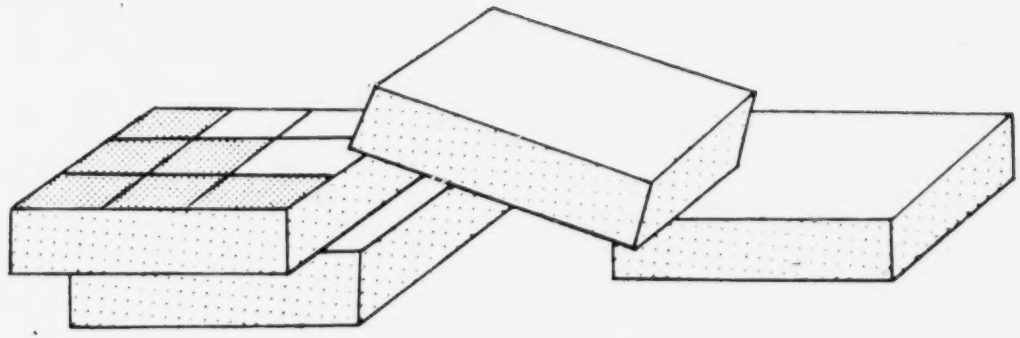
5. Let one child give the other children a description of a pattern and let the other children construct the pattern and extend it.

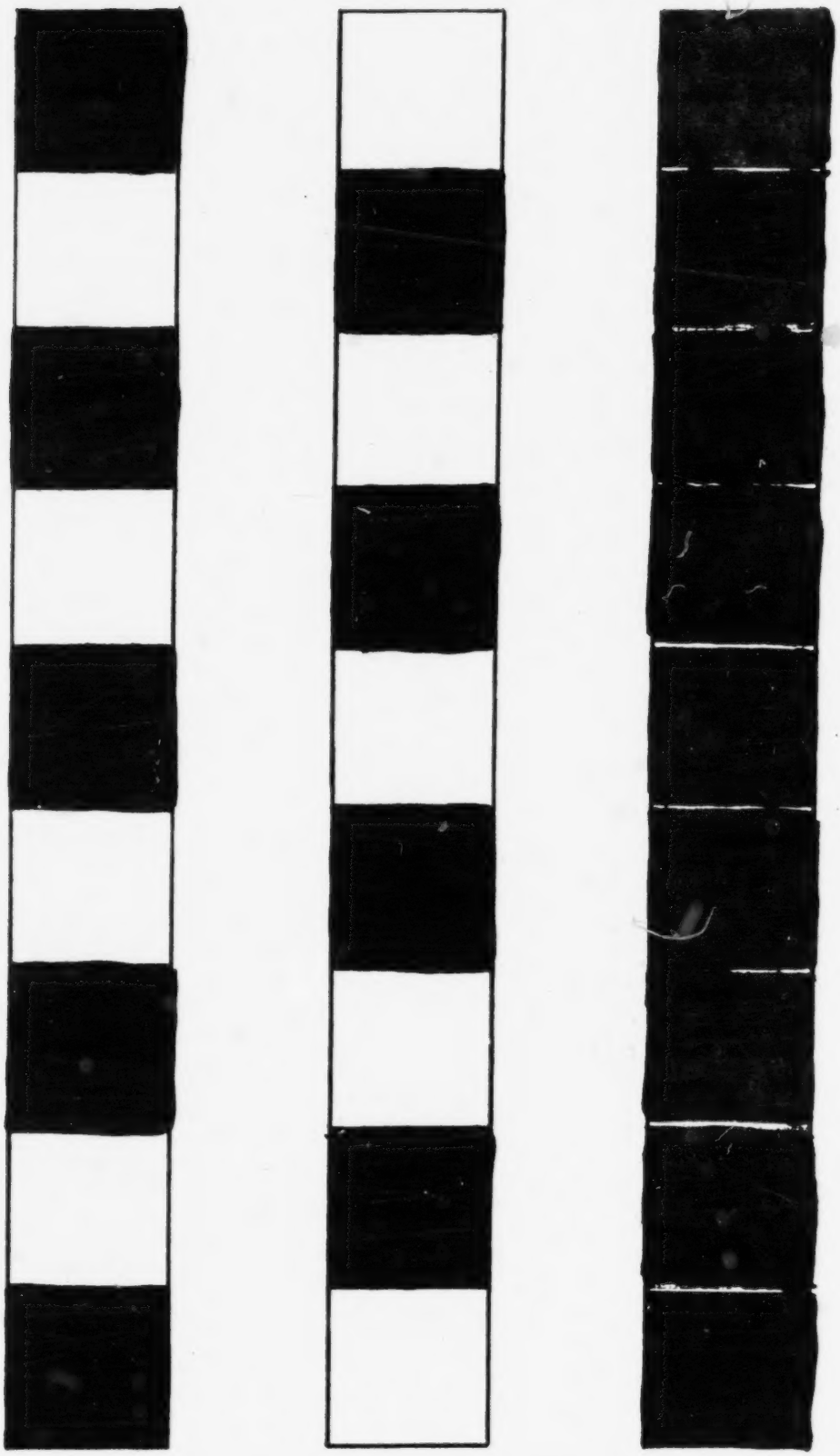
APPENDIX A

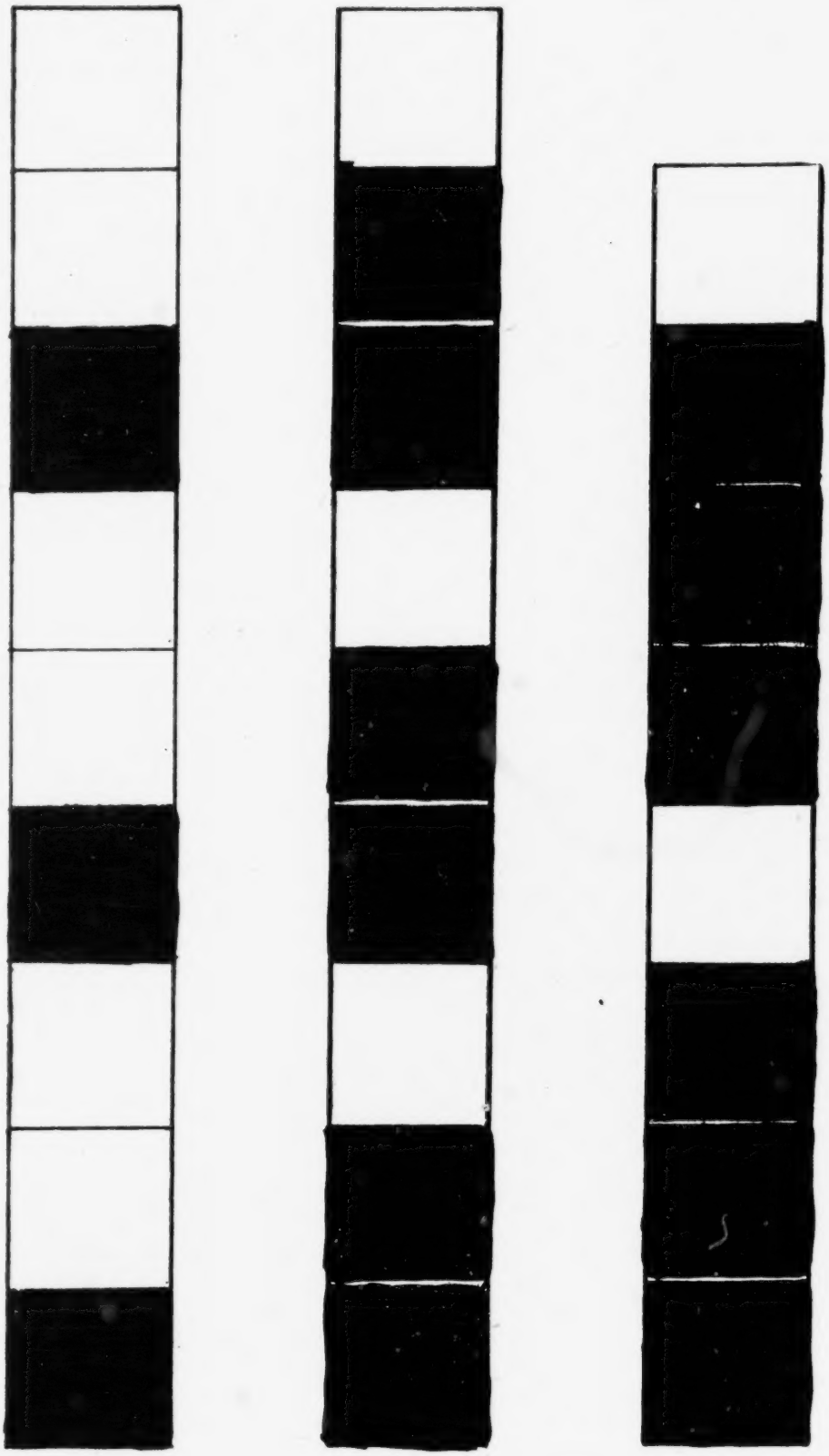


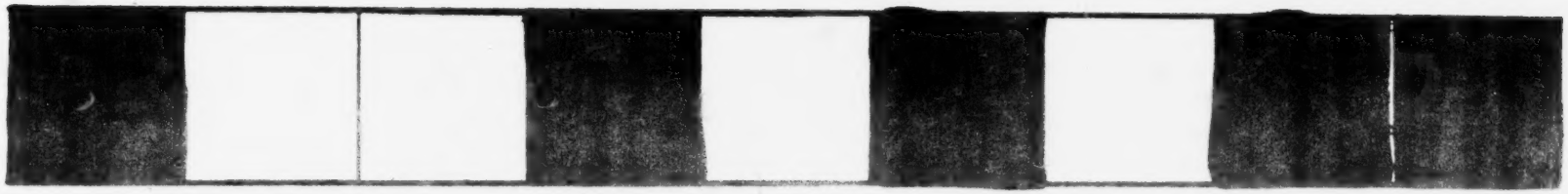
PATTERNS

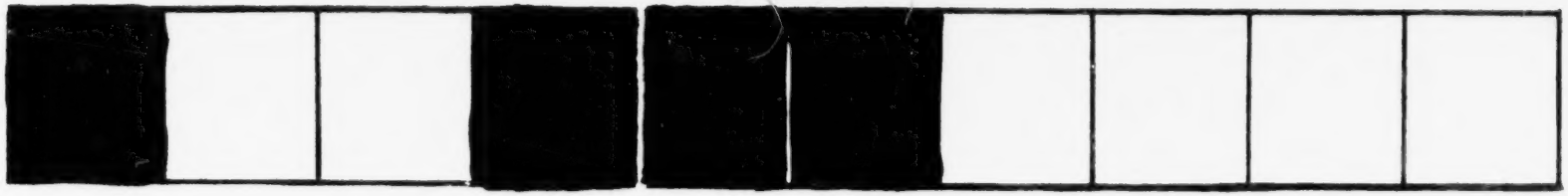
GEORGIA
REMARKABLE
DUCK
COMPANY

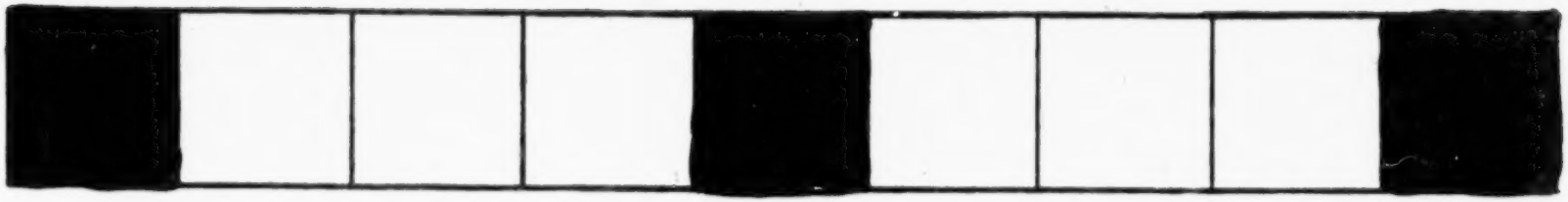


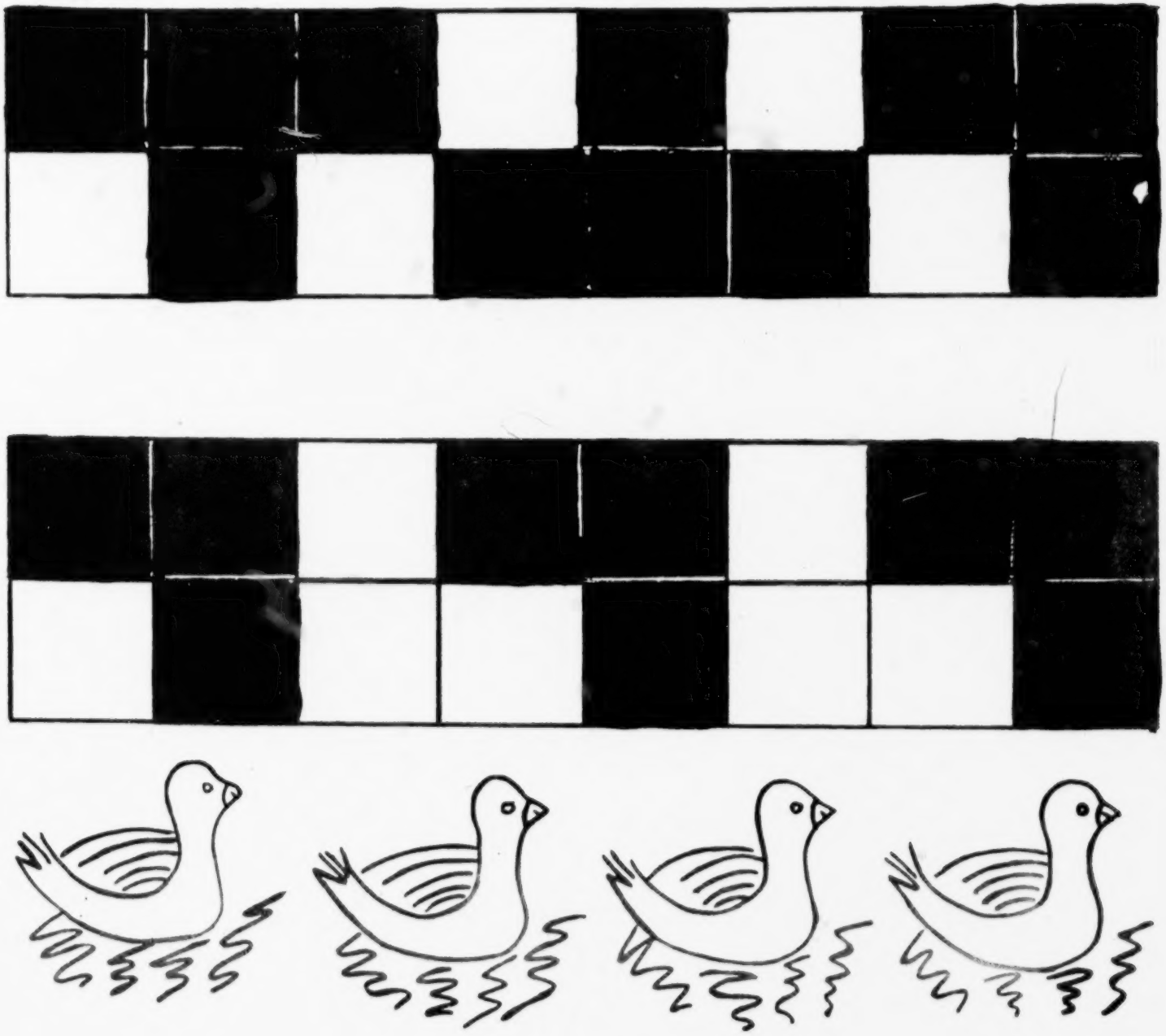


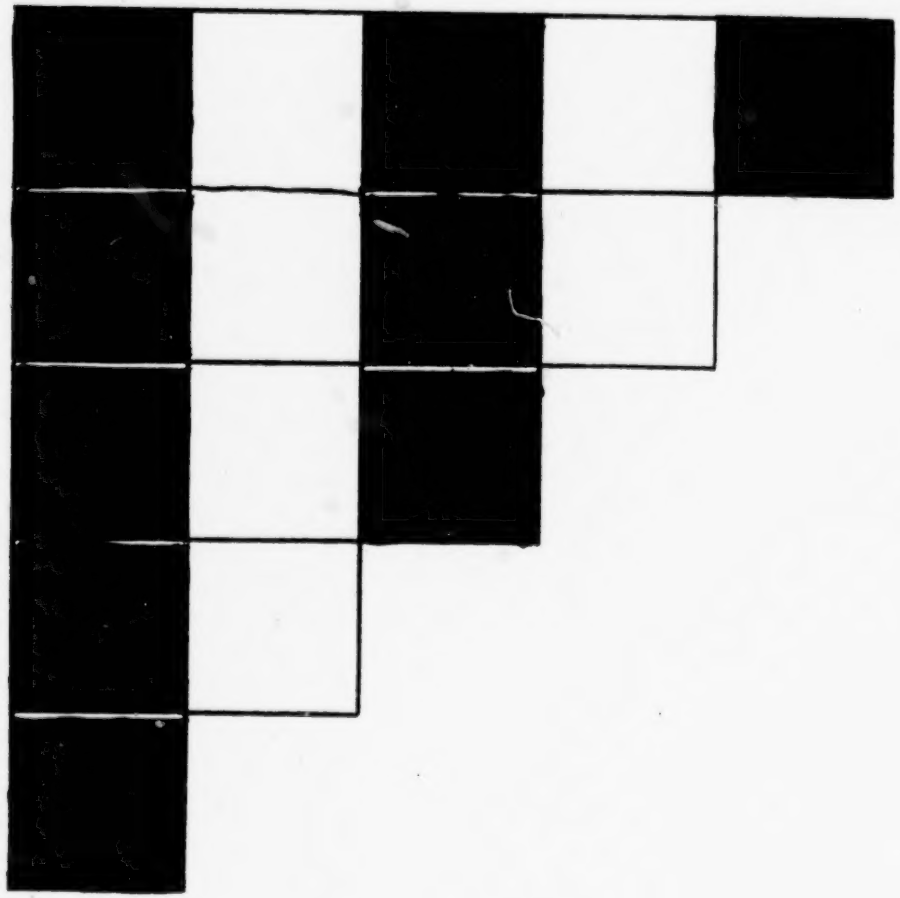


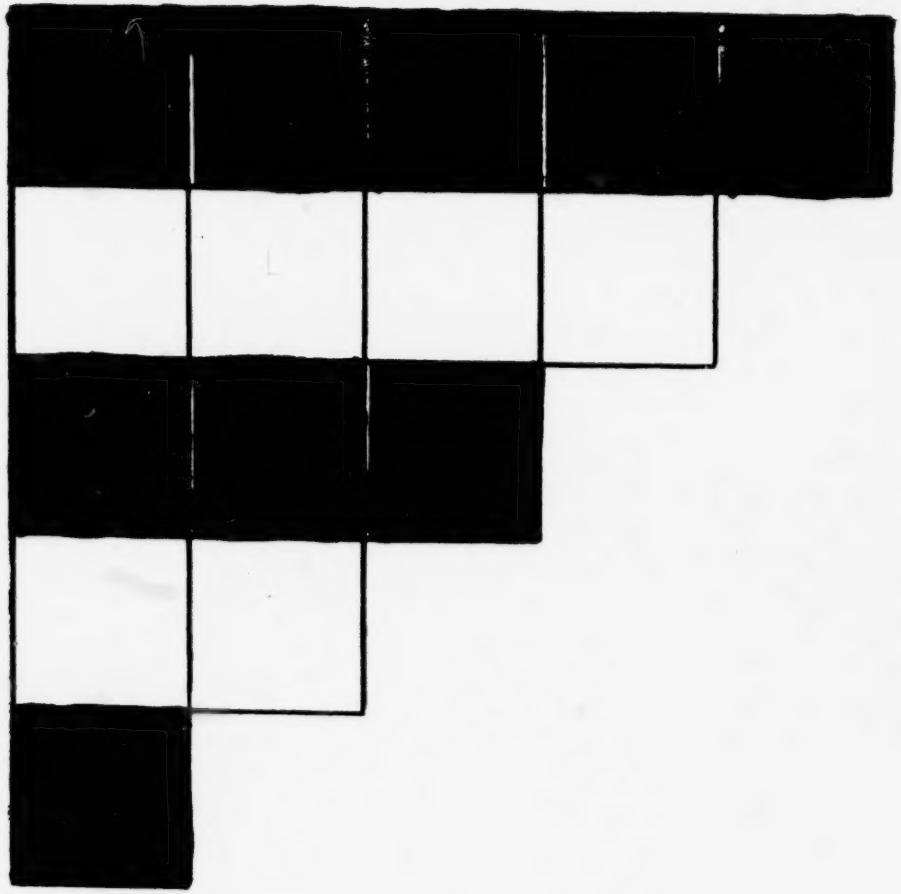


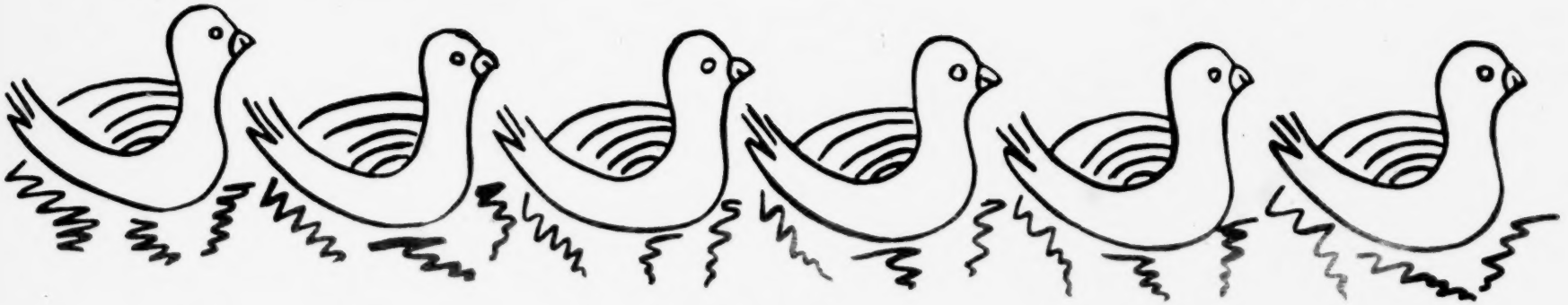












APPENDIX B